MYCN gene

MYCN proto-oncogene, bHLH transcription factor

Normal Function

The *MYCN* gene provides instructions for making a protein that plays an important role in the formation of tissues and organs during embryonic development. Studies in animals suggest that this protein is necessary for normal development of the limbs, heart, kidneys, nervous system, digestive system, and lungs. The MYCN protein regulates the activity of other genes by attaching (binding) to specific regions of DNA. On the basis of this action, this protein is called a transcription factor.

The *MYCN* gene belongs to a class of genes known as oncogenes. When mutated, oncogenes have the potential to cause normal cells to become cancerous. The *MYCN* gene is a member of the Myc family of oncogenes. These genes play important roles in regulating cell growth and division (proliferation) and the self-destruction of cells (apoptosis).

Health Conditions Related to Genetic Changes

Feingold syndrome

At least 29 mutations involving the *MYCN* gene have been found to cause Feingold syndrome. Most mutations lead to a premature stop signal in the instructions for making the protein. In some cases of Feingold syndrome, the entire *MYCN* gene is deleted. These genetic changes prevent one copy of the gene in each cell from producing any functional MYCN protein. As a result, only half the normal amount of this protein is available to control the activity of specific genes during embryonic development. It remains unclear how a reduced amount of the MYCN protein causes the varied features of Feingold syndrome.

neuroblastoma

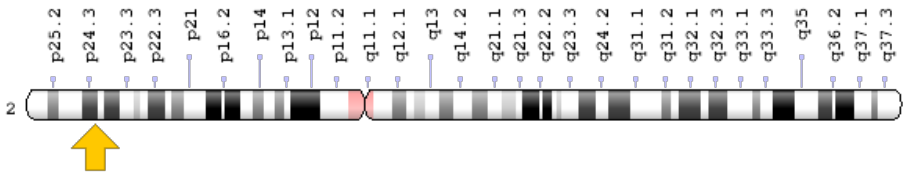
Some gene mutations are acquired during a person's lifetime and are present only in certain cells. These changes, which are not inherited, are called somatic mutations. Somatic mutations sometimes occur when DNA makes a copy of itself (replicates) in preparation for cell division. Errors in the replication process can result in one or more extra copies of a gene within a cell. The presence of extra copies of certain genes, known as gene amplification, can underlie the formation and growth of tumor cells. For example, amplification of the *MYCN* gene is found in about 25 percent of neuroblastomas. Neuroblastoma is a type of cancerous tumor that arises in developing nerve cells. The number of copies of the *MYCN* gene varies widely

among these tumors but is typically between 50 and 100. Amplification of the *MYCN* gene is associated with a more severe form of neuroblastoma. It is unknown how amplification of this gene contributes to the aggressive nature of neuroblastoma.

Chromosomal Location

Cytogenetic Location: 2p24.3, which is the short (p) arm of chromosome 2 at position 24.3

Molecular Location: base pairs 15,940,438 to 15,947,007 on chromosome 2 (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- bHLHe37
- MYCN_HUMAN
- MYCNOT
- N-myc
- N-myc proto-oncogene protein
- neuroblastoma-derived v-myc avian myelocytomatosis viral related oncogene
- neuroblastoma MYC oncogene
- NMYC
- oncogene NMYC
- pp65/67
- v-myc avian myelocytomatosis viral oncogene neuroblastoma derived homolog
- v-myc avian myelocytomatosis viral related oncogene, neuroblastoma derived
- v-myc myelocytomatosis viral related oncogene, neuroblastoma derived
- v-myc myelocytomatosis viral related oncogene, neuroblastoma derived (avian)

Additional Information & Resources

Educational Resources

- Cancer Medicine (sixth edition, 2003): Gene Amplification
  https://www.ncbi.nlm.nih.gov/books/NBK12538/#A1400
- National Cancer Institute: Neuroblastoma
  https://www.cancer.gov/types/neuroblastoma

GeneReviews

- Feingold Syndrome 1
  https://www.ncbi.nlm.nih.gov/books/NBK7050

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28MYCN%5BTI%5D%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+720+days%22%5Bdp%5D

OMIM

- V-MYC AVIAN MYELOCYTOMATOSIS VIRAL-RELATED ONCOGENE, NEUROBLASTOMA-DERIVED
  http://omim.org/entry/164840

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/NMYCID112.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=MYCN%5Bgene%5D
- HGNC Gene Family: Basic helix-loop-helix proteins
  http://www.genenames.org/cgi-bin/genefamilies/set/420
- HGNC Gene Symbol Report
  http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=7559
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/4613
- UniProt
  http://www.uniprot.org/uniprot/P04198

Sources for This Summary

- Albertson DG. Gene amplification in cancer. Trends Genet. 2006 Aug;22(8):447-55. Epub 2006 Jun 19. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16787682
- GeneReview: Feingold Syndrome 1
  https://www.ncbi.nlm.nih.gov/books/NBK7050
- Jacobs JF, van Bokhoven H, van Leeuwen FN, Hulsbergen-van de Kaa CA, de Vries IJ, Adema GJ, Hoogerbrugge PM, de Brouwer AP. Regulation of MYCN expression in human neuroblastoma cells. BMC Cancer. 2009 Jul 18;9:239. doi: 10.1186/1471-2407-9-239.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/19615087
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2720985/
- Marcelis CL, Hol FA, Graham GE, Rieu PN, Kellermayer R, Meijer RP, Lugtenberg D, Scheffer H, van Bokhoven H, Brunner HG, de Brouwer AP. Genotype-phenotype correlations in MYCN-related Feingold syndrome. Hum Mutat. 2008 Sep;29(9):1125-32. doi: 10.1002/humu.20750.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/18470948
- Schwab M, Alitalo K, Klempnauer KH, Varmus HE, Bishop JM, Gilbert F, Brodeur G, Goldstein M, Trent J. Amplified DNA with limited homology to myc cellular oncogene is shared by human neuroblastoma cell lines and a neuroblastoma tumour. Nature. 1983 Sep 15-21;305(5931):245-8.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/6888561
- Tang XX, Zhao H, Kung B, Kim DY, Hicks SL, Cohn SL, Cheung NK, Seeger RC, Evans AE, Ikegaki N. The MYCN enigma: significance of MYCN expression in neuroblastoma. Cancer Res. 2006 Mar 1;66(5):2826-33.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16510605
- OMIM: V-MYC AVIAN MYELOCYTOMATOSIS VIRAL-RELATED ONCOGENE, NEUROBLASTOMA-DERIVED
  http://omim.org/entry/164840
- Van Roy N, De Preter K, Hoebeeck J, Van Maerken T, Pattyn F, Mestdagh P, Vermeulen J, Vandesompele J, Speleman F. The emerging molecular pathogenesis of neuroblastoma: implications for improved risk assessment and targeted therapy. Genome Med. 2009 Jul 27;1(7):74. doi: 10.1186/gm74.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/19638189
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2717400/
- Vasudevan SA, Nuchtern JG, Shohet JM. Gene profiling of high risk neuroblastoma. World J Surg. 2005 Mar;29(3):317-24. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15706435
- van Bokhoven H, Celli J, van Reeuwijk J, Rinne T, Glaudemans B, van Beusekom E, Rieu P, Newbury-Ecob RA, Chiang C, Brunner HG. MYCN haploinsufficiency is associated with reduced brain size and intestinal atresias in Feingold syndrome. Nat Genet. 2005 May;37(5):465-7. Epub 2005 Apr 10.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15821734

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